PIPE-TO-WALL CONNECTIONS

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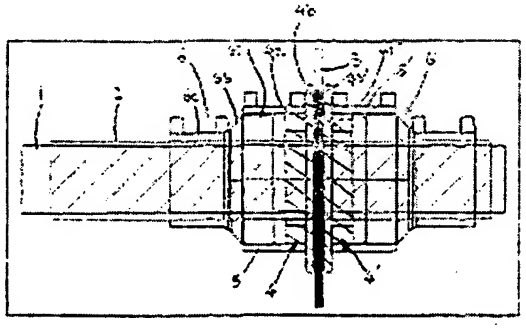
A fitting for providing a substantially fluid-tight seal between an opening in a chamber wall (3) and a pipe (1) passing through said opening, said fitting comprising:- (i) a first tubular sleeve (4a); (ii) a flange (4b), attached to said first tubular sleeve (4a), and extending radially outwardly from said first tubular sleeve (4a), a first surface of the flange (4b) being configured to contact the chamber wall (3) around substantially the whole circumference of the opening and over substantially the whole first surface of the flange (4b), the first surface at least of said flange being formed from a material which is readily bondable to GRP; (iii) securing means adapted to secure said flange to said first tubular sleeve in a fluid tight manner.



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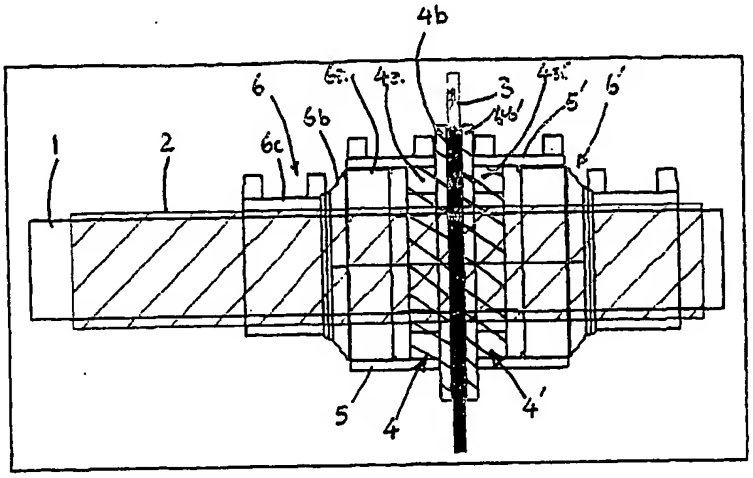

(57) Abstract: A fitting for providing a substantially fluid-tight seal between an opening in a chamber wall (3) and a pipe (1) passing through said opening, said fitting comprising:- (i) a first tubular sleeve (4a); (ii) a flange (4b), attached to said first tubular sleeve (4a), and extending radially outwardly from said first tubular sleeve (4a), a first surface of the flange (4b) being configured to contact the chamber wall (3) around substantially the whole circumference of the opening and over substantially the whole first surface of the flange (4b), the first surface at least of said flange being formed from a material which is readily bondable to GRP; (iii) securing means adapted to secure said flange to said first tubular sleeve in a fluid tight manner.

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PIPE-TO-WALL CONNECTIONS

Field of the Invention

The present invention concerns improvements in and relating to connecting of secondary contained pipework to a wall of a sump/ tank or the like. Such secondary contained pipework is best exemplified by pipework used for conveying organic fluids such as petroleum products which represent an explosion risk or toxic hazard if leaked. In general these have a primary pipe that carries the fluid further housed within an outer/ secondary pipe and often with the primary pipe concentrically positioned within the secondary pipe. The present invention provides methods and means of securely connecting the secondary contained pipework to the sump/ tank wall and facilitates the monitoring of the integrity of the connection as well as monitoring the interstitial space between the primary and secondary pipes and the interstitial space between a double-walled sump/chamber.

Background to the invention

Subterranean piping systems of the type that are typically installed at service stations are generally utilized to communicate fuel or chemicals between an underground storage tank and an above ground dispensing station. The underground storage tanks and associated piping pose serious potential environmental and fire hazards as the chemicals contained therein could and have in the past leaked into the earth.

Oil companies have been under considerable pressure to ensure that environmental concerns are given priority in the planning and installation of petrol station infrastructures. This has not been without significant on-cost. One important advancement has been the use of pipeline systems constructed from plastics materials which have enabled the oil companies to install cost-effective environmentally acceptable alternatives to steel pipework systems which tend to corrode over time.

In petroleum forecourt installations, pipework running between dispensing pumps and a subterranean fuel storage tank passes into a manhole chamber which is situated directly above the manhole lid of the tank. The chamber is normally defined

by an upstanding wall which, when viewed from above, can be of an octagonal, square, circular or rectangular shape, and which includes apertures through which respective pipes pass.

To overcome environmental concerns this pipework is now generally constructed from plastics materials and many current designs of forecourt installation utilise secondary containment. This involves containing each fuel supply pipeline in a respective secondary containment pipeline which is optionally sealed at its ends to the fuel supply pipeline. The secondary containment pipeline prevents leaks from the fuel supply pipeline from being discharged into the environment, and also can convey leaked petrol to a remote-sensing device. Typically, the pipes forming the secondary containment pipeline are initially separate from the fuel pipes and are sleeved over the latter as the fuel pipes are installed between the fuel storage tanks and dispensing pumps.

A common material for the chamber to be constructed from is glass-reinforced plastic which involves moulding a resin or other polymeric material reinforced with fibres such as glass fibres.

It is desirable to provide a seal between each of the apertures in the chamber wall and its respective pipe to avoid ingress of water into the manhole chamber. To that end, it is known to attach a fitting to a portion of the wall around the aperture and a rubber "boot" that sleeves over the pipe and is clamped to both the pipe and the fitting by, for example, jubilee (TM) clips. Some types of such fitting are bolted to the chamber wall, whilst other types of fitting provide inner and outer parts between which the wall is sandwiched, the inner and outer parts being held together by a screw-threaded connector which extends through the aperture. These connectors often incorporate a rubber seal located between a part of the connector and the chamber wall.

Neither type of fitting provides a completely effective seal.

Over time, both types of seal can allow water to leak into the manhole chamber and to accumulate in a pool in the bottom of the chamber. This in turn makes the maintenance of the chamber bottom and tank entrance extremely difficult. In

addition a defective seal can allow any petroleum fluid or vapours which find their way into the chamber to escape into the environment.

It would be preferable if such a fitting could be chemically bonded or electrofusion welded both to the pipe and to the chamber wall. One type of such fittings, manufactured from a plastics material capable of electrofusion to both the pipe and the chamber wall is known from GB2332255 (PetroTechnik Ltd). However, these fittings cannot be used when the chamber is constructed from GRP, a material commonly used in construction of chambers and sumps for this application.

In summary therefore, in the event that pipework has to be replaced, or in new build situations, there is a requirement to seal pipework made from polyethylene, polypropylene, polyamide or the like to a GRP chamber wall. Accordingly it is an object of the present invention to provide a fitting for forming a seal between pipework formed from a plastics materials and a GRP chamber which overcomes some or all of the above disadvantages.

Summary of the Invention

According to a first aspect of the present invention there is provided apparatus for connecting secondary contained pipework to a wall of a sump/ tank or the like where the wall is of a heat weldable plastics material such as, for example, PE, as defined in Claim 1.

The apparatus suitably comprises :

a fitting suitably for providing a substantially fluid-tight seal between an opening in the wall and the pipe passing through the opening, the fitting comprising:

a tubular sleeve adapted to allow the pipe to pass through the sleeve; a flange, extending radially outwardly from the sleeve, a first surface of the flange being configured to contact the wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange; and an energy transfer means incorporated in the flange and situated at or near the first surface of the flange, the energy transfer means being adapted to heat the first surface of the flange in order to form a substantially fluid tight seal between the wall and the flange.

Preferably the fitting is substantially rigid and the first surface of the flange is a substantially rigid, flat, planar surface. Suitably the first surface comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the fitting and the wall to be fused together. Preferably the energy transfer means comprises conduction means for conducting an electric current, the conduction means in use being heated by the current to cause the heating of the first surface.

According to a second aspect of the present invention there is provided apparatus for connecting secondary contained pipework to a GRP wall of a sump/ tank or the like, as defined in Claims 12, 29 and 32.

The apparatus suitably comprises :

a fitting suitably for providing a substantially fluid-tight seal between an opening in the wall and the pipe passing through the opening, the fitting comprising:

a tubular sleeve adapted to allow the pipe to pass through the sleeve; a flange, extending radially outwardly from the sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange; and a GRP element bonded to the flange and situated at or near the first surface of the flange whereby the fitting may be secured to the wall to form a substantially fluid tight seal between the wall and the flange by resin bonding the GRP element to the wall. Further aspects of this apparatus will become apparent from the following.

Accordingly, a preferred embodiment comprises a fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising a first component comprising:-

(i) a first tubular sleeve adapted to allow the pipe to pass through the sleeve;

(ii) a flange, extending radially outwardly from the sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange;

(iii) an energy transfer means incorporated in the flange and situated at or near the first surface of the flange, said energy transfer means being adapted to heat the first surface of the flange in order to form a substantially fluid tight seal between the wall and the flange;

characterised in that the outer surface of said first tubular sleeve is adapted to be electrofusible.

Preferably the fitting assembly further incorporates a second component, said second comprising;

(i) a second tubular sleeve comprising a first region which forms a tight sliding fit with the outer surface of the first tubular sleeve and a second region adapted to form a tight sliding fit with a separate component;.

Preferably said first and second regions of the second tubular sleeve further incorporate energy transfer means, said energy transfer means being adapted to heat the first and second regions order to form a substantially fluid tight seal between the first component and the second component and between the second component and the separate component.

Preferably the second component comprises;

(i) a first part incorporating one or more energy transfer means;

(ii) a second tubular sleeve part adapted at a first region to form a tight sliding fit with the inside of said first part, said second tubular sleeve part adapted at a second region to form a tight sliding fit with the outside of said pipe, said second region further incorporating an energy transfer means.

In a particularly preferred embodiment the first surface of the flange comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the fitting and the wall to be fused together.

Preferably the second component comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the flange, the second component and the pipe to be fused together.

Preferably the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the first surface.

Preferably the sleeves are of a substantially circular cross-section, and the flange is radial.

Preferably the fitting includes terminals for connecting the conduction means to a current supply.

Preferably the fitting is adapted for use with a wall which is of a material which is not suitable for being attached to the fitting by electrofusion, the first surface of the fitting incorporating an adhesive of a type which is activated by heat, wherein the heating of the first surface by the energy transfer means activates the adhesive and thereby bonds the fitting to the wall.

Preferably the adhesive is selected from a thermoplastic, thermoset, cross-linking or pressure sensitive adhesive.

According to a further aspect there is provided a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

(i) a first tubular sleeve;

(ii) a flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said flange being formed from a material which is readily bondable to GRP;

(iii) securing means adapted to secure said flange to said first tubular sleeve in a fluid tight manner.

Preferably the first tubular sleeve incorporates energy transfer means.

Preferably the first tubular sleeve is formed from an electrofusible plastic material which at least partially melts when heated via the energy transfer means, causing the first tubular sleeve and the pipe to be fused together in a substantially fluid tight manner.

Preferably the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the first surface.

Preferably the conduction means comprises a heating wire which is embedded within the tubular sleeve.

Preferably the fitting includes terminals for connecting the conduction means to a current supply.

Preferably the flange is substantially formed from GRP.

Preferably the first tubular sleeve is adapted to form a tight sliding fit with a pipe.

Alternatively the first tubular sleeve is adapted to form a tight sliding fit with a reducer and wherein the reducer is further adapted to form a tight sliding fit with a pipe and further incorporates energy transfer means.

Preferably the securing means are formed from a plastics material.

Preferably the securing means are incorporated within the first tubular sleeve.

Alternatively the securing means are formed from metal.

Preferably the first tubular sleeve is attached to the securing means by crimping.

Alternatively the first tubular sleeve is attached to the securing means by swaging.

Preferably the flange is attached to the chamber wall by a resin or adhesive.

According to a still further aspect of the present invention there is provided a fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising:-

a first fitting component comprising:-

a first tubular sleeve;

a first flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the second flange being configured to contact the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said first flange being formed from a material which is readily bondable to GRP;

first securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

a second fitting component comprising:-

a second tubular sleeve;

a second flange, attached to said second tubular sleeve, and extending radially outwardly from said second tubular sleeve, a first surface of the second flange being configured to contact the other of the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said second flange being formed from a material which is readily bondable to GRP;

second securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

means to attach the first fitting component to the second fitting component.

Preferably the means to attach the first fitting component to the second fitting component comprise attaching the first securing means to the second securing means.

Preferably the securing means are attached together by complementary screw threads.

The invention also provides a fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising:-

a first fitting component comprising:-

a first tubular sleeve;

a first flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the second flange being configured to contact the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said first flange being formed from a material which is readily bondable to GRP;

first securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

a second fitting component comprising a second tubular sleeve and second securing means adapted to secure said second tubular sleeve to a third fitting component in a fluid tight manner;

said third fitting component comprising a second flange, extending radially outwardly from said second tubular sleeve, a first surface of the second flange being configured to contact the other of the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said second flange being formed from a material which is readily bondable to GRP, said flange;

said third fitting component able to be secured to said second securing means.

Preferably the second flange is slidable along the second securing means to allow the fitting to accommodate chamber walls of different widths.

It will be appreciated that the invention also extends to methods of manufacturing such fittings and fitting assemblies, to chambers incorporating them and to forecourt installations in which they are used.

The above aspects are not limiting of the full scope of this disclosure and other inventive aspects of the present disclosure will also become apparent from the following description and accompanying drawings.

Brief Description of the Drawings

Preferred embodiments of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a schematic diagram illustrating a first preferred embodiment of the first aspect of the invention wherein the connection fitting is energy welded in place to the wall;

Figure 2 is a schematic diagram similar to Figure 1 but illustrating a second preferred embodiment of the first aspect of the invention;

Figure 3 is a schematic diagram similar to Figure 1 but illustrating a third preferred embodiment of the first aspect of the invention;

Figures 4a-c are schematic diagrams, respectively illustrating the Figure 3 embodiment as deployed together with further components for;

Figure 5 is a schematic diagram similar to Figure 1 but illustrating a first preferred embodiment of the second aspect of the invention, in which the connection apparatus is adhesive/ resin bonded in place to a GRP wall;

Figure 6 is a schematic diagram based on Figure 5 but illustrating the connection apparatus as deployed at both inlet and outlet ends of a tank installation and showing interlinkage of the inlet and outlet connection apparatus by a linking bypass tube;

Figure 7 is substantially the same as Figure 6 but with the inner 125 to 75mm PE reducing boot reversed to shorten the connecting assembly;

Figure 8 is substantially the same as Figure 6 but with 125 to 63mm PE inner reducing boot (test port needs to be inserted into the PE boot);

Figure 9 is a schematic diagram of an alternative embodiment of the second aspect of the invention in which a substantially conventional pair of rubber boots are spring band clamped onto GRP spigots, the GRP spigots suitably being round or in the form of rings that are resin fastened to the sump wall 30; and

Figure 10 is a diagram similar to Figure 9 but in which the secondary containment pipe is shown as discontinuous at the sump wall 30; and

Figure 11 illustrates an alternative embodiment of the second aspect of the invention, in which the flange is adhesive/resin bonded to a GRP wall, and is connected to the tubular sleeve via a metal securing means, the tubular sleeve being electrofusible to a pipe.

Description of the Preferred Embodiments

The present embodiments represent currently the best ways known to the applicant of putting the invention into practice. But they are not the only ways in which this can be achieved. They are illustrated, and they will now be described, by way of example only. By way of terminology used in this document the following definitions apply:-

chamber – any receptacle designed to keep a fluid in or out. This includes, but is not limited to, manhole and sump chambers as described herein. It also includes tanks in general.

energy transfer means – a generic term describing any form of energy source. Typically it takes the form of a resistance winding which heats up when an electrical current is passed through it. The term also encompasses other welding techniques including ultrasonic welding and induction welding.

flange – any collar suitable for attaching a fitting to a chamber wall. In the examples given the surface of the flange which contacts the chamber wall is substantially planar. However, it will be understood that the flange must conform to the profile of the chamber wall around the pipe inlet opening. Thus the flange can adopt any suitable conformation to achieve the necessary contact with a flat or curved surface or even the corner of a container wall.

fluid – whilst the examples provided relate mainly to liquids, the term fluid refers to liquids, vapours and gases. For example, should a leak occur in a secondarily contained pipe in a garage forecourt installation then petrol or petrol vapour will collect in the manhole chamber. It is essential that this petrol vapour cannot escape through the wall of the chamber and into the surrounding ground.

pipe – the examples given herein are for a generally circular cross-sectioned single wall pipe. However, the invention also covers other cross-sections such as box sections, corrugated and the like and secondarily contained pipes of the "pipe-within-a-pipe" type. In this case the sealing member or boot for sealing the sleeve to the pipe will be rather more complex. However, such boots are well known in the art. The invention also encompasses pipes which are not circular in cross-section.

tubular sleeve - this term has a very broad meaning. It includes any tubular structure through which a pipe may pass. Although illustrated and described as substantially circular cylindrical in form, a sleeve according to this invention need not have a substantially circular cross-section and may confirm to the profile of the pipe to be accommodated in it. Nor need the cross-section of the sleeve be uniform along its whole length, ie it need not be cylindrical.

Glass reinforced plastic (GRP) – The term GRP has a very broad meaning in this context. It is intended to encompass any fibre-reinforced plastic wherein a fibre of any type is used to strengthen a thermosetting resin or other plastics material.

Referring firstly to Figure 1, this shows a primary fluid conveying pipe 1 that is ensheathed in a secondary containment pipe 2 and with the primary and secondary pipes passing together through the wall 3 of a sump or other tank. The secondary pipe 2 is secured to the wall 3 in a fixed position by a connection assembly.

A first connection assembly embraces the secondary containment pipe 2 as it passes through the sump wall 3 from the left hand side (exterior of the tank) and a mirror image of the assembly embraces the secondary containment pipe 3 on the right hand (inner) side of the wall 3. Each connection assembly comprises an electrofusion entry seal component 4; a short pipe section coupling component 5; and a reducing boot 6. Each of these components 4,5,6 of the connection assembly is suitably a relatively rigid polyethylene (PE) moulding.

In one example embodiment, the electrofusion entry seal component 4 has an outside diameter of 125mm and sits within one end of the short pipe section coupling component 5, the coupling component 5 being of substantially 125mm internal diameter. At the other end of the coupling component 5 is received the larger diameter end 6a of the reducing boot that is 125mm in outside diameter, the reducing boot 6 tapering 6b to a reduced diameter portion 6c that is merely 75mm in outside diameter.

The electrofusion seal component 4 is configured to be electrofusion welded to the sump wall 3, the sump wall 3 being of polyethylene or similar heat weldable material. The coupling component 5 is similarly adapted to be electrofusion welded to a first sleeve on the electrofusion entry seal component 4 and also to the larger outside diameter portion 6a of the reducing boot 6. To complete the installation of

the connection assembly each reducing boot 6 is also adapted to be electrofusion welded to the respective part of secondary containment pipe 2 along the reduced diameter portion 6c of the reducing boot 6.

It will be appreciated from the above that the first sleeve on the component 4 has an outer surface which is electrofusible. That is to say, the outer surface of that sleeve is substantially planar, at lest at the region furthest from the flange. Planar in this context means that it is a smooth cylindrical surface which can form a tight sliding fit with a cylindrical fitting slid over it. This is in contrast with earlier fittings where the sleeves are of non-uniform cross-section.

The electrofusion entry seal component 4 is formed as a tubular sleeve that has an inside diameter sufficient to accommodate passage therethrough of the secondary containment pipe 2 and has a radially outwardly extending flange portion 4b with a first surface of the flange portion 4b being configured to contact the sump wall 3 around substantially the whole circumference of the opening though the sump wall 3 and suitably over substantially the whole of the surface of the flange that faces the sump wall 3.

As noted above, the assembly of electrofusion entry seal component 4, electrofusion coupling component 5 and reducing boot 6 may be repeated in mirror image 4', 5', 6' on the internal face of the sump wall 3.

It will immediately be appreciated by those skilled in the art that this arrangement is particularly advantageous when forming a fluid tight seal to a double walled chamber. By bonding an electrofusion seal component 4,4' on both the inside and outside of he chamber wall the interstitial space within the wall remains intact. The interstitial space may be monitored in conventional manner by providing a suitable port in the fitting.

Referring now to Figure 2, this shows a second preferred embodiment of the first aspect of the present invention differing in that the secondary containment pipe 2 is discontinuous and instead of having a mirror image pair of electrofusion entry seal components 4, there is only one such component but of which the tubular sleeve portion 4a extends not only in the direction away from the sump wall 3 but also in the opposing direction and actually extends through the hole formed in the sump

wall 3. Here the electrofusion entry seal component 4 is welded to the sump wall 3 only from the outer face.

The secondary containment pipe 2 terminates within the reducing boot 6, 6' on each respective opposing side of the sump wall 3. This arrangement is particularly suitable for use in a single wall chamber situation.

Referring to Figure 3, this shows a third embodiment of the first aspect of the present invention in which, as with the first embodiment, a pair of electrofusion entry seal components 4 are provided in mirror image of each other, one on each side of the sump wall 3. As with the second embodiment, the secondary containment pipe 2 is discontinuous. Accordingly, this third embodiment is configured to provide optimal versatility in seal integrity testing, enabling the integrity of each boot 6, 6' to be tested as well as the integrity of the electrofusion seal to the wall 3.

Referring now to Figures 5 to 8, these illustrate implementations of a first preferred embodiment of a second aspect of the present invention, for providing a connection between pipework and a GRP wall 30. Commonly double walled sumps, especially in America, are formed of GRP (fibreglass) and do not enable the use of the electrofusion approach to securing pipework in place extending through the sump wall 30.

The materials specialist will be aware that it is difficult, if not impossible, to form a fluid tight, long lasting seal between a GRP component and a component formed from an electrofusible plastics material using currently available materials.

Referring to Figure 5, here the primary fluid conveying pipe 1 is again held within a secondary containment pipe 2 and where the secondary containment pipe 2 is discontinuous at the GRP sump double wall 30 with only the primary pipe 1 passing through the sump double wall 30. In common with the first embodiment of the first aspect of the invention, the mounting assembly comprises a seal component 14 that is substantially the same in form as the electrofusion entry seal component 4 of the Figure 1 embodiment but which is not adapted for electrofusion welding (since as noted above electrofusion welding of polyethylene to GRP is ineffective).

The entry seal component 14 couples with a tubular coupling component 5 and which in turn couples with a reducing boot 6 in the same manner as in the Figure 1 embodiment. Again, the coupling component 5 is electrofusion welded to the seal component 14 and to the reducing boot 6 and the reducing boot 6 is electrofusion welded to the secondary containment pipe 2.

Two main additional components are present in this embodiment – a GRP backing ring 16 and a GRP locking ring 17.

The GRP backing ring is a large flat ring that is configured to encircle the primary fluid conveying pipe 1 and to be pushed flat against, and epoxy resin bonded to, the GRP double sump wall 30 in use. Prior to this, however, the GRP backing ring 16 is first bonded to the radial flange part 14b of the polyethylene seal component 14 by use of a compatible adhesive – suitably methacrylate. The GRP backing ring 16 alone may not in all cases provide a sufficiently secure attachment of the seal component 14 to the GRP sump wall 30 and accordingly, GRP lock ring 17, is suitably provided first fitted over the radial flange 14a of the sealing component 14 and epoxy resin bonded to the GRP backing ring 16, with the GRP lock ring 17 and the GRP backing ring 16 trapping the sealing component 14 between them. The GRP backing ring 16 and GRP lock ring 17 are hence suitably assembled in place on the sealing component 14 prior to offering up the backing ring 16 to the sump wall 30 and adhering both the GRP backing ring 16 and lock ring 17 to the sump wall 30 with epoxy resin or other GRP compatible adhesive.

As a further measure to protect the adhesive bond and in particular the methacrylate adhesive which might otherwise be vulnerable to the solvent effect of the petroleum fluids carried by the fluid conveying pipe 1, elastomeric sealing elements are suitably provided. As illustrated in Figure 5, there is one elastomeric O-ring seal 20 provided at the interface between the flange 14b of the sealing component 14 and the GRP backing ring 16 and with a further O-ring 21 at the interface between the radial flange 14b and the GRP lock ring 17. These O-rings, 20, 21, are suitably held within corresponding annular recesses provided in the respective opposing faces at the interfaces.

It will be self-evident that the locking ring arrangement described above is just one of a number of securing means which could be used to attack a flange which is

readily bondable to a GRP chamber wall to a sleeve formed from an electrofusible plastics material. Further examples of other securing means are described below.

Examples of securing means suitable for use in the present invention include fixing a metal component to the sleeve of plastics material. Thus a fluid-tight metal-to-plastics seal may be formed using known technology and the GRP flange is then bounded to metal, again using known technology. The metal component, which is generally tubular or sleeve-lime in configuration, thus acts as a securing means to secure the GRP flange to the plastics material sleeve.

The plastics material sleeve may incorporate electrofusion windings such that it can form a fluid-tight electrofusion seal to a pipe, primary or secondary, or to another fitting component.

A mirror image of this fitting may be provided on the opposite face of the chamber wall. Alternatively, the plastics material sleeve can be extended to span the chamber wall and a second flange component and second securing means applied from the other side of the wall. These components can be held in place by adhesive, by a screw thread arrangement, by bolts or other fixings or by clamp(s).

Figure 11 illustrates the fitting 122. In this embodiment, fitting 122 comprises three portions, a first portion 130 and a second portion 131.

Turning first to portion 130, a first end 133, has an internal diameter which is a tight sliding fit over the outside of the secondary pipe 134. Portion 130 is thus generally cylindrical in shape with non-uniform cross-section having a longitudinal axis through which a secondary pipe may pass through the entire body of the portion.

In this particular embodiment, the first portion 130 is formed from plastics material, such that the inner surface, at least, is electrofuseable to the outer surface of the primary and secondary pipe, to form a substantially fluid tight seal there between.

The inner surface 136 of the portion 130 accommodates energy transfer means, in this case windings 137 of electrical heating wire which lie close to, or at, the internal surface of the portion 130. These windings are electrically connected to terminal

pins 138,139 projecting from the plastics portion 130. The terminal pins 138,139 can be shrouded by hollow cylindrical plastic terminal shrouds 140,141 projecting from, and integral with, the portion 130. The methodology for laying heating wires of this type on the inner surface of a plastics fitting is well known.

The first portion of the fitting is joined in a substantially fluid type manner during manufacture to the second portion 131. Portion 131 is generally manufactured of metal but can be manufactured from any material able to bond to the GRP flange. In this example the second portion 131 is made of metal and is crimped or externally swaged 143 onto the first portion. An outwardly extending flange or hook 142 engages with a shoulder or step 158 on the first portion 130 to prevent lateral or axial movement of the first portion 130 once the joint between them has been made and provides greater strength and stability once the two components are joined together. The second portion 131 can be slotted radially or longitudinally to resist any movement of the plastic component 130. In order to improve the fluid-tight nature of the seal between these two components, a series of grooves, slots or ridges (not shown) can be formed in the region where the two sleeves overlap. When the joint is formed, plastics material fills these grooves, preventing the two components from separating in use.

Optionally, the seal between the two components can be further improved by incorporating a sealing means such as an O-ring (not shown). The O-ring nests into a annular channel around the circumference of one or other of the portions. It will be appreciated that the O-ring seal can be positioned during assembly on either the first or second portion. For ease of construction it would normally be positioned on the outer surface of the first portion, towards the end of that portion which is located within the body of the fitting itself.

It will be appreciated that the O-ring could also be positioned in the end face of the first portion, engaging with a shoulder in the second portion.

Because the O-ring is internal to the fitting, and sealed within, it is expected to have a very long life, at least the life of the fitting.

The second portion 131 has an internal diameter which can accommodate the secondary pipe 134, either leaving a space 144 or, as an alternative embodiment, as a tight sliding fit over the outside of the secondary pipe 134.

The flange 146 is bonded to the outer surface 145 of the second portion. In an alternative embodiment the flange could be an integral part of the second portion. It is clear that the flange could be manufactured from metal, GRP or any other material which can adhere to a GRP chamber wall. O-rings 170 can optionally be provided to further improve the seal between the flange and the second portion.

The flanges 146 is adapted to conform to and engage with the surface of the chamber wall 160. Thus the flange(s) may be flat if the sides of the chamber are flat or curved if the chamber has curved walls.

The diameter, size, shape, depth and pitch of threads of this component are designed to allow the flange(s) to thread onto and over the corresponding end of the second portion.

The flange, may be formed as an integral part of the second portion 131. This provides for increased strength in the fitting but does mean that the fitting may only pass through the aperture in the chamber wall in one direction.

To bond the flange to the wall, GRP resin, glass fibre mat or other adhesive is applied to the face of the flange or to the chamber wall around the aperture. Similar adhesive is applied to the flange/chamber wall on the outside of the chamber. Alternatively the flange(s) may be clamped firmly against the chamber wall and resin or other suitable adhesive applied over substantially the whole exposed surface of the flange and the surrounding area. This will also result in a strong fluid-tight seal.

In a further alternative resin/adhesive may be applied to both faces of the flange, both between the flange and the chamber wall and over the external, exposed face of the flange.

Further notes on drawings

Figure 1

PE Single Wall, Basic Principle, Version One

One 125mm welded Electrofusion entry seal on outside wall of sump

Welded PE 125 to 75mm reducing boots and 125mm welding couplers

Secondary continuous into sump

Allows pipe interstitial to be monitored separately

No band clamps. Permanently welded

Boots will not perish or fail

If required, PE boot could be fitted with test port and tube allowing connection (or isolation) to the pipe secondary termination

If the boot is not to be monitored then the internal PE boot can be eliminated

Figure 2

PE Single Wall, Basic Principle, Version 2

One 125mm welded Electrofusion entry seal on outside wall of sump.

Welded PE 125 to 75mm reducing boots and 125mm welding couplers

Green secondary cut between PE boots

Allows interstitial and boots only to be monitored

No band clamps. Permanently welded

Boots will not perish or fail.

If the boot is not to be monitored then the internal PE boot can be eliminated

Figure 3

PE Single Wall, Basic Principle, Version 3

As above but two modified 125mm welded Electrofusion entry seals-

One each side of the SW PE sump wall

Allows boots and the Electrofusion ring weld to be monitored.

No band clamps. Permanently welded.

Boots will not perish or fail.

Figure 4

a) System using 49 series welded test boot termination

Ideal provided sump has adequate width for the assembly.

b) System as above but with inner 125 to 75mm

PE reducing boot reversed to shorten assembly.

c) System using 125 to 63mm PE inner reducing boot

Test port needs to be inserted into the PE boot.

Figure 5

PRINCIPLE uses PE and Fibreglass bond

Plain PE 305 non Electrofusion seal

Methacralyte adhesive onto an FRP backing ring but with O ring insert as barrier to potential fuel exposure.

PE ring locked in place with outer FRP collar and adhesive

Entire assembly could be prepared off site, site process being resin of the FRP ring to the FRP sump wall

As shown, the entire system intercommunicates- sumps, product lines, vapor lines, seals

If the pipe secondary wall is continuous through the seal then the sump and seal could be continuously monitored by linking the sump to say the vapor line only.

Figure 6

Note, if the sump is double wall then there is no need for the bypass tube as the sump itself communicates.

A variant on this would be to have no break in the secondary pipe through the seal, then the bypass tube would be needed.

The Seal could be interconnected to the secondary pipe wall using a tube and tee.

LIST of some of the Innovative Features

1. Use of (PE) entry boot welded both sides, as a continuation of the secondary containment
2. Testability of the boot with pressure, vacuum or liquid eg brine/ glycol
3. Communication of the boot with a double wall sump
4. Communication of the boot with the pipe secondary containment
5. Integration of O rings into the adhesive frp/ pe solution
6. Use of a FRP backing ring to attach either a pe ring/boot or a flexible boot/ band clamp
7. Testability of the entire seal and the weld using a double EF seal
8. Clamping/ encapsulation PE ring in FRP , with adhesive, with O rings

Claims

1. A fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising a first component comprising:-

(i) a first tubular sleeve adapted to allow the pipe to pass through the sleeve;

(ii) a flange, extending radially outwardly from the sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange;

(iii) an energy transfer means incorporated in the flange and situated at or near the first surface of the flange, said energy transfer means being adapted to heat the first surface of the flange in order to form a substantially fluid tight seal between the wall and the flange;

characterised in that the outer surface of said first tubular sleeve is adapted to be electrofusible.

2. A fitting assembly as claimed in Claim 1 in further incorporating a second component, said second comprising;

(ii) a second tubular sleeve comprising a first region which forms a tight sliding fit with the outer surface of the first tubular sleeve and a second region adapted to form a tight sliding fit with a separate component;.

3. A fitting assembly as claimed in Claim 2 wherein said first and second regions of the second tubular sleeve further incorporate energy transfer means, said energy transfer means being adapted to heat the first and second regions order to form a substantially fluid tight seal between the first component and the second component and between the second component and the separate component.

4. A fitting assembly as claimed in Claim 2 or Claim 3 in which the second component comprises;

(i) a first part incorporating one or more energy transfer means;

(ii) a second tubular sleeve part adapted at a first region to form a tight sliding fit with the inside of said first part, said second tubular sleeve part adapted at a second region to form a tight sliding fit with the outside of said pipe, said second region further incorporating an energy transfer means.

5. A fitting assembly according to any preceding Claim, in which the first surface of the flange comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the fitting and the wall to be fused together.

6. A fitting assembly according to any of Claims 2 to 5 inclusive, in which the second component comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the flange, the second component and the pipe to be fused together.

7. A fitting assembly according to any preceding Claim, in which the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the first surface.

8. A fitting assembly according to any preceding Claim, in which the sleeves are of a substantially circular cross-section, and the flange is radial.

9. A fitting assembly according to any preceding Claim, in which the fitting includes terminals for connecting the conduction means to a current supply.

10. A fitting assembly according to any preceding claim, in which the fitting is adapted for use with a wall which is of a material which is not suitable for being attached to the fitting by electrofusion, the first surface of the fitting incorporating an adhesive of a type which is activated by heat, wherein the

heating of the first surface by the energy transfer means activates the adhesive and thereby bonds the fitting to the wall.

11. A fitting assembly according to Claim 10, in which the adhesive is selected from a thermoplastic, thermoset, cross-linking or pressure sensitive adhesive.

12. A fitting for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

(i) a first tubular sleeve;

(ii) a flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the flange being configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said flange being formed from a material which is readily bondable to GRP;

(iii) securing means adapted to secure said flange to said first tubular sleeve in a fluid tight manner.

13. A fitting according to Claim 12 wherein the first tubular sleeve incorporates energy transfer means.

14. A fitting according to Claims 12 to 13 wherein the first tubular sleeve is formed from an electrofusible plastic material.

15. A fitting according to Claim 12 to 14 wherein the electrofusible material at least partially melts when heated via the energy transfer means, causing the first tubular sleeve and the pipe to be fused together in a substantially fluid tight manner.

16. A fitting according to Claims 12 to 15 wherein the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the first surface.

17. A fitting according to Claims 12 to 16 wherein the conduction means comprises a heating wire which is embedded within the tubular sleeve.

18. A fitting according to Claims 12 to 17 wherein the fitting includes terminals for connecting the conduction means to a current supply.

19. A fitting according to Claims 10 to 18 wherein the flange is substantially formed from GRP.

20. A fitting according to Claims 10 to 19 wherein the first tubular sleeve is adapted to form a tight sliding fit with a pipe.

21. A fitting according to Claims 10 to 19 wherein the first tubular sleeve is adapted to form a tight sliding fit with a reducer.

22. A fitting according to Claim 21 wherein the reducer is further adapted to form a tight sliding fit with a pipe and further incorporates energy transfer means.

23. A fitting according to Claims 12 to 22 wherein the securing means are formed from a plastics material.

24. A fitting according to claim 23 wherein the securing means are incorporated within the first tubular sleeve.

25. A fitting according to Claims 12 to 22 wherein the securing means are formed from metal.

26. A fitting according to Claim 25 wherein the first tubular sleeve is attached to the securing means by crimping.

27. A fitting according to Claim 25 wherein the first tubular sleeve is attached to the securing means by swaging.

28. A fitting according to Claims 12 to 27 wherein the flange is attached to the chamber wall by a resin or adhesive.

29. A fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising:-

a first fitting component comprising:-

a first tubular sleeve;

a first flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the second flange being configured to contact the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said first flange being formed from a material which is readily bondable to GRP;

first securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

a second fitting component comprising:-

a second tubular sleeve;

a second flange, attached to said second tubular sleeve, and extending radially outwardly from said second tubular sleeve, a first surface of the second flange being configured to contact the other of the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said second flange being formed from a material which is readily bondable to GRP;

second securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

means to attach the first fitting component to the second fitting component.

30. A fitting assembly according to Claim 29 wherein the means to attach the first fitting component to the second fitting component comprise attaching the first securing means to the second securing means.

31. A fitting assembly according to Claim 30 wherein the securing means are attached together by complementary screw threads.

32. A fitting assembly for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising:-

a first fitting component comprising:-

a first tubular sleeve;

a first flange, attached to said first tubular sleeve, and extending radially outwardly from said first tubular sleeve, a first surface of the second flange being configured to contact the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said first flange being formed from a material which is readily bondable to GRP;

first securing means adapted to secure said first flange to said first tubular sleeve in a fluid tight manner;

a second fitting component comprising a second tubular sleeve and second securing means adapted to secure said second tubular sleeve to a third fitting component in a fluid tight manner;

said third fitting component comprising a second flange, extending radially outwardly from said second tubular sleeve, a first surface of the second flange being configured to contact the other of the inner or the outer of the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange, the first surface at least of said second flange being formed from a material which is readily bondable to GRP, said flange;

said third fitting component able to be secured to said second securing means.

33. A fitting according to Claim 32 wherein the second flange is slidable along the second securing means to allow the fitting to accommodate chamber walls of different widths.

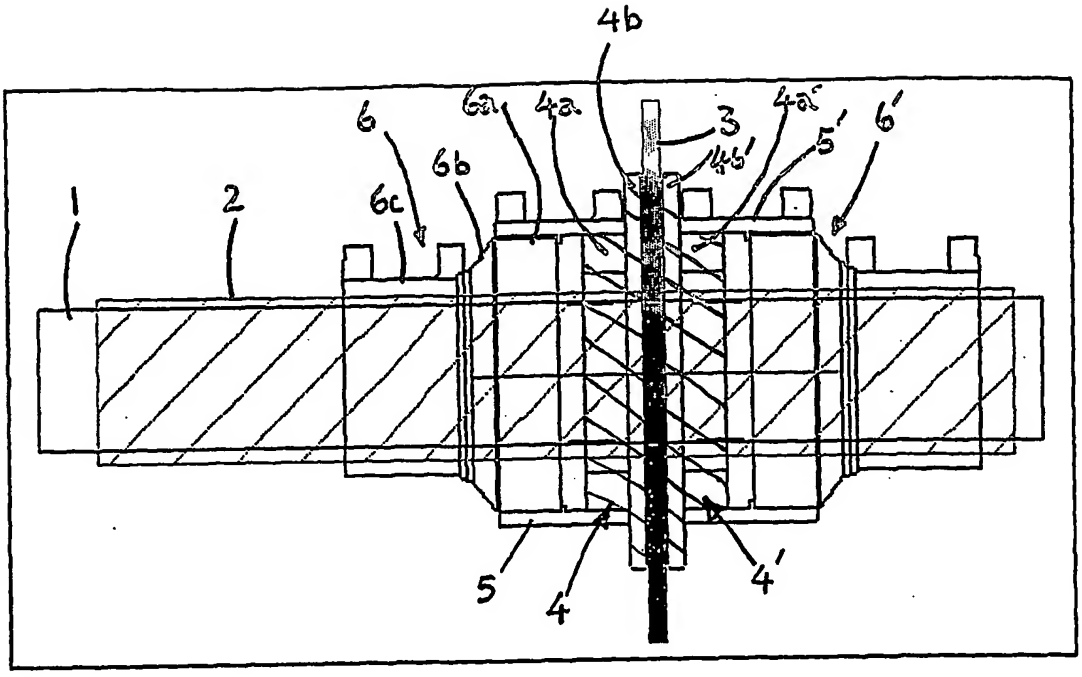


Figure 1

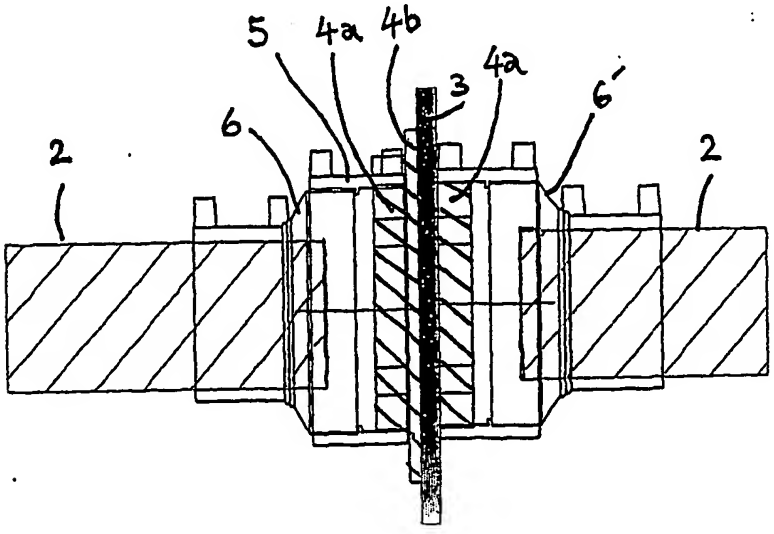


Figure 2

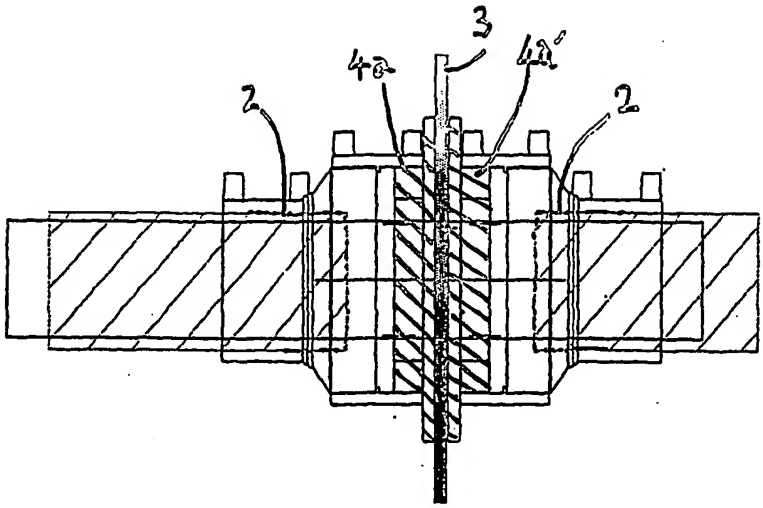


Figure 3

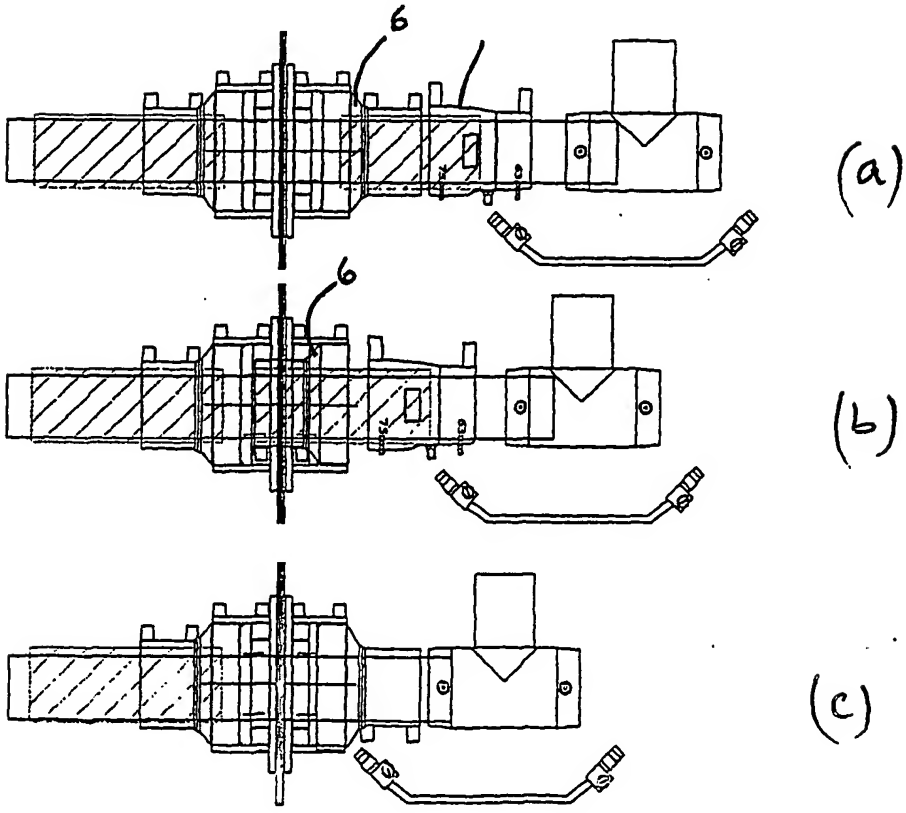


Figure 4

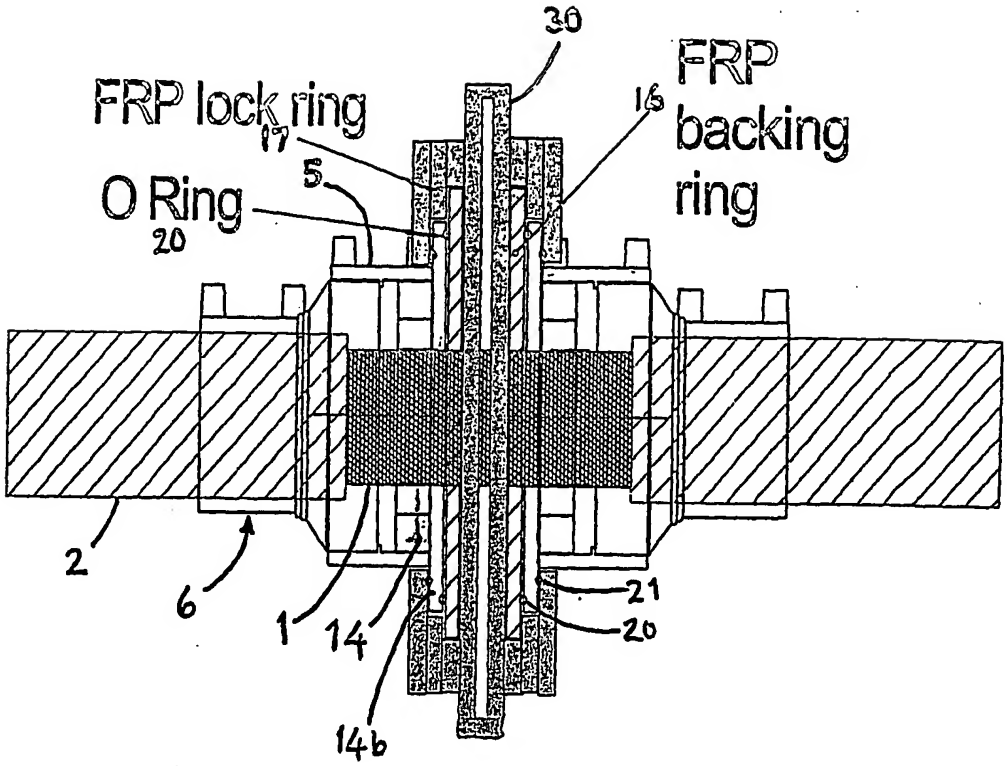


Figure 5

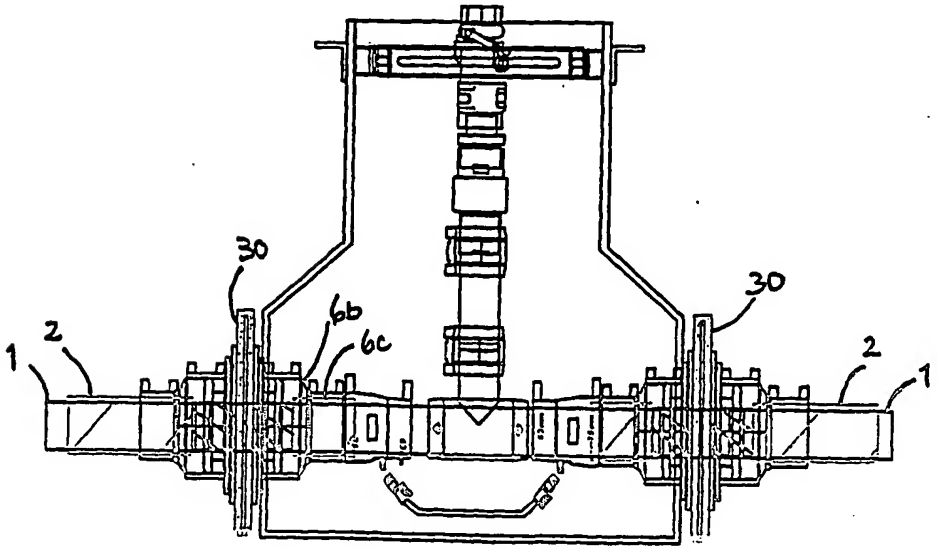


Figure 6

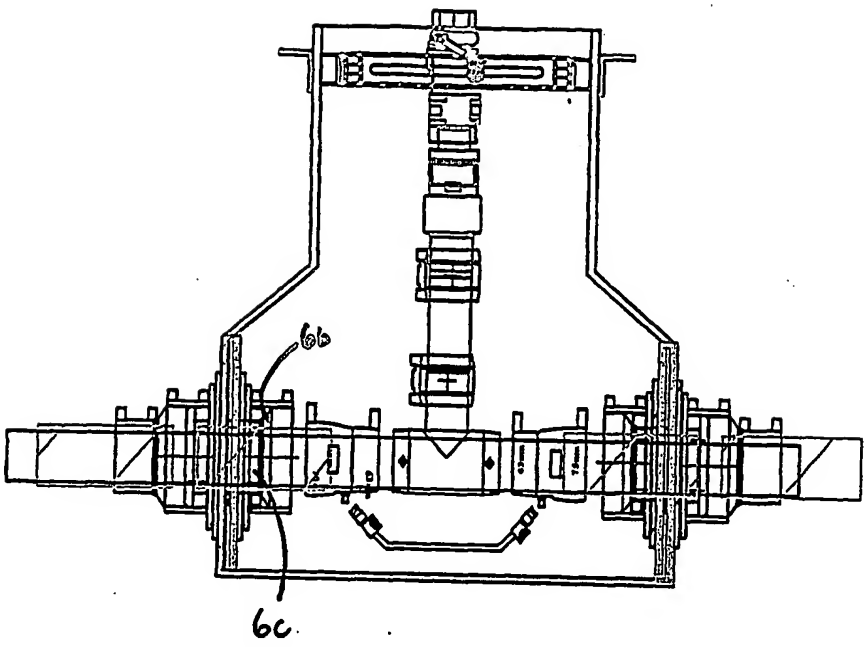


Figure 7

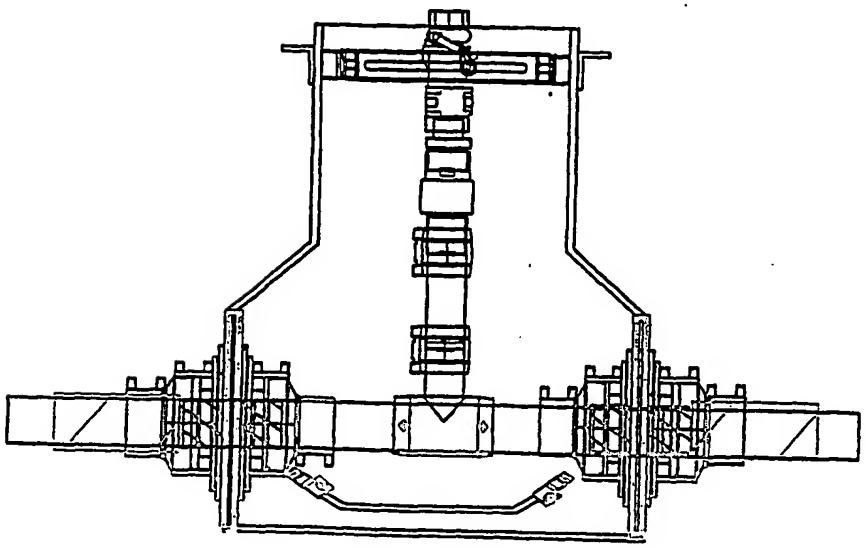


Figure 8

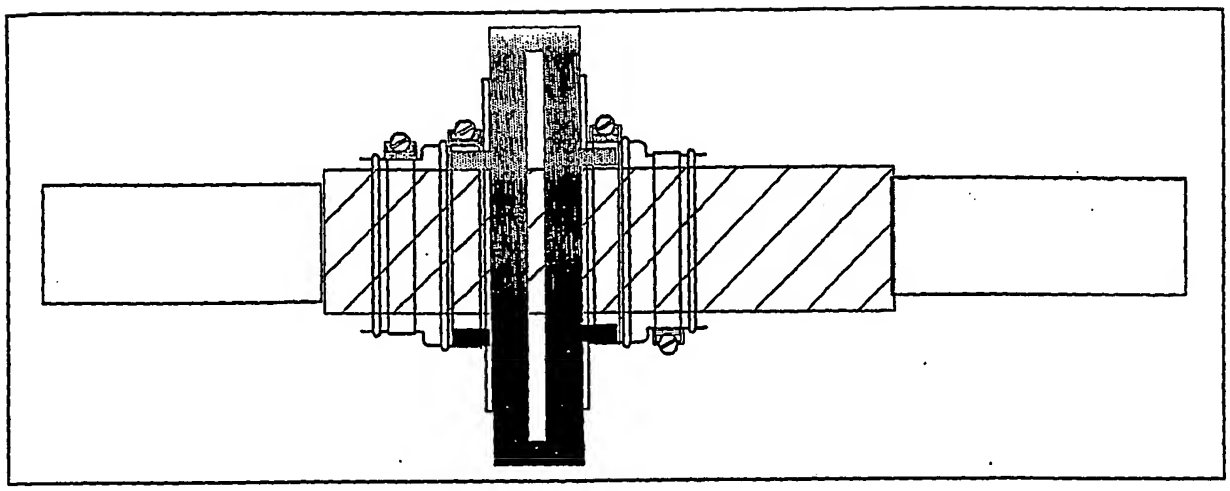


Figure 9

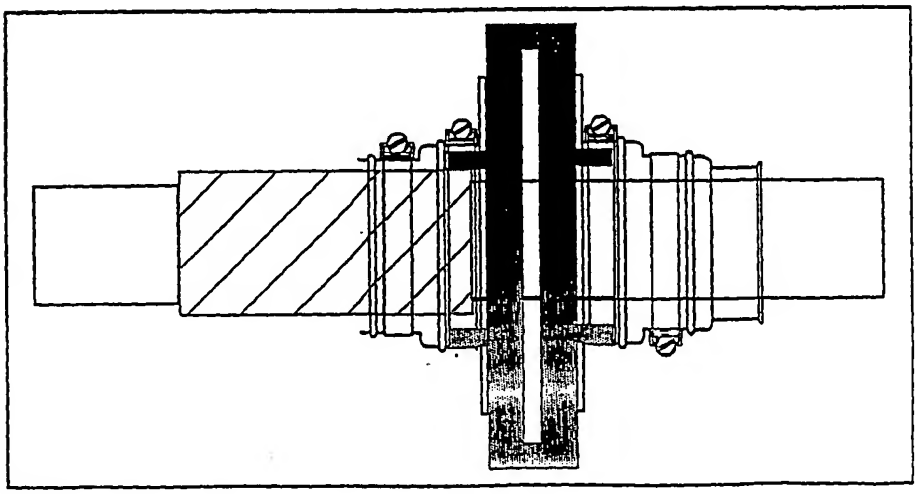
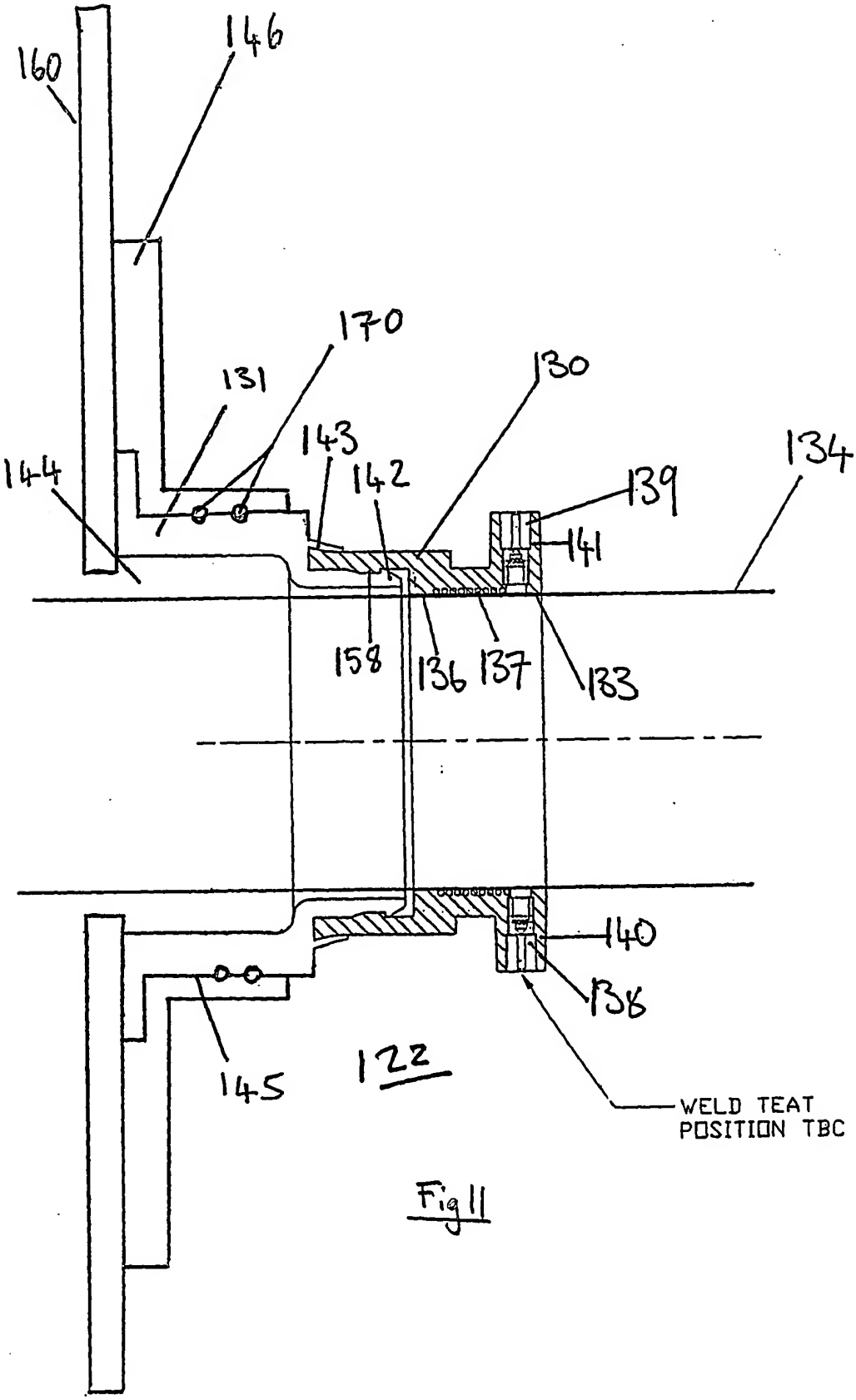


Figure 10


160
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WELD TEAT POSITION TBC

Fig 11

INTERNATIONAL SEARCH REPORT

ıational Application No
PCT/GB2004/000931

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16L5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 332 255 A (PETROTECHNIK LTD) 16 June 1999 (1999-06-16) cited in the application page 2 -page 5	1,2,4-21
A	page 9 -page 11 claims 1-11 figures 2,4,5	3,22-33

A	US 6 171 029 B1 (MCGILL MILTON D ET AL) 9 January 2001 (2001-01-09) column 1, line 60 -column 2, line 9 column 3, line 12 - line 36 column 5, line 17 - line 65 claims 4,5,13,14 figures 1,3-5	1-33

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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'A' document defining the general state of the art which is not considered to be of particular relevance

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'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'O' document referring to an oral disclosure, use, exhibition or other means

'P' document published prior to the international filing date but later than the priority date claimed

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'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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'&' document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 June 2004	16/06/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Jankowska, M

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INTERNATIONAL SEARCH REPORT

National Application No
PCT/GB2004/000931

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

national Application No
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